What Is Claimed Is:

1. A method for modifying a hexahedral volume mesh, comprising:

generating a sheet of hexahedral elements from a hexahedral volume mesh, wherein said mesh includes a plurality of three-dimensional (3D) hexahedrons each having six quadrilateral faces and eight nodes, each node formed at three intersecting edges, and wherein said sheet includes a subset of the plurality of 3D hexahedrons;

determining a group of hexahedrons within said sheet to refine;

shrinking said group; and

inserting a new sheet of hexahedrons into the hexahedral volume mesh.

2. The method of Claim 1, wherein the six quadrilateral faces for each 3D hexahedron include three sets of opposing faces, wherein generating a sheet includes:

selecting a first hexahedron, the selected hexahedron having a first set of opposing faces, the first set including a first opposing face and a second opposing face;

determining a first neighboring hexahedron, the first neighboring hexahedron sharing the first opposing face with the selected hexahedron;

selecting the first neighboring hexahedron, the first neighboring hexahedron having another face opposite the shared first opposing face;

repeating steps b) and c) until a predetermined sheet edge threshold being satisfied;

determining a second neighboring hexahedron, the second neighboring hexahedron sharing the second opposing face with the selected hexahedron;

selecting the second neighboring hexahedron, the second neighboring hexahedron having another face opposite the shared second opposing face;

repeating steps e) and f) until the sheet edge threshold being satisfied;

grouping all selected hexahedrons into a first column of hexahedrons;

selecting the first hexahedron, the selected hexahedron having a second set of opposing faces, the second set including a third opposing face and a fourth opposing face;

18 determining a third neighboring hexahedron, the third neighboring hexahedron sharing the third opposing face with the selected hexahedron;

20 selecting the third neighboring hexahedron;

repeating steps a) through h) until a second column of hexahedrons is grouped;

22 selecting the first hexahedron;

determining a fourth neighboring hexahedron, the fourth neighboring hexahedron sharing the

24 fourth opposing face with the selected hexahedron;

selecting the fourth neighboring hexahedron;

26 repeating steps a) through h) until a third column of hexahedrons is grouped;

repeating steps a) through p) until the sheet edge threshold being satisfied; and

28 grouping all columns of hexahedrons into the sheet.

3. The method of Claim 1, wherein generating a sheet includes:

2 selecting a hexahedron, the selected hexahedron having three sets of opposing faces from the six quadrilateral faces, each set including a first opposing face and a second opposing face;

4 determining a neighboring hexahedron to refine, the neighboring hexahedron sharing one face with the selected hexahedron;

6 repeating step b) until all neighboring hexahedrons have been found;

selecting the neighboring hexahedron to refine;

8 repeating steps a) through d) until all hexahedrons in the sheet have been found.

4. The method of Claim 1, wherein determining a group of hexahedrons includes identifying said group using one of a point, line, and surface of the mesh.

5. The method of Claim 1, wherein determining a group of hexahedrons within said sheet to

2 refine includes:

selecting a hexahedron in the group to refine, the selected hexahedron having three sets of opposing faces from the six quadrilateral faces, each set comprising a first opposing face and a second opposing face;

identifying the one set of opposing faces that are not shared by another hexahedron in the sheet, the set including a first unshared opposing face and a second unshared opposing face;

determining a distance between the first unshared opposing face and the second unshared opposing face;

repeating steps a) through c) for each hexahedron in the group to refine;

comparing the distance for each hexahedron in the group to refine;

determining the hexahedron with a shortest distance;

calculating a ratio of the distance for each hexahedron in the sheet to refine to the shortest distance;

comparing the ratio to a refinement threshold;

grouping each hexahedron identified to refine into the group; and

repeating steps g) through i) for each hexahedral in the group to refine.

6. The method of Claim 1, wherein shrinking said group includes:

moving exterior nodes of the group from an original position into the volume of each hexahedron; and

maintaining a copy of each exterior node in the original position.

7. The method of Claim 1, wherein shrinking said group includes pillowing.

8. The method of Claim 1, wherein inserting a new sheet of hexahedrons into the hexahedral volume mesh includes:

separating each hexahedron in the group from the hexahedral volume mesh;

forming a void in the hexahedral volume mesh; and

inserting the new sheet of hexahedrons into the void.

9. A method for generating a hexahedral volume mesh by inserting a sheet of hexahedrons, comprising:

generating an initial hexahedral volume mesh, wherein the mesh includes a plurality of three-dimensional (3D) hexahedrons, each 3D hexahedron having six quadrilateral faces and nodes, each node formed at three intersecting edges;

determining an area to refine in the initial mesh;

generating a sheet from said area, wherein the sheet includes a subset of the plurality of 3D hexahedrons;

defining a group of hexahedrons within said sheet to refine;

shrinking said group; and

inserting a new sheet of hexahedrons into the hexahedral volume mesh.

10) The method of Claim 9, wherein generating a sheet includes using a dual of the initial hexahedral mesh.

11. The method of Claim 9, wherein determining an area to refine includes identifying said area using one of a point, line, and surface of the mesh.

12. The method of Claim 9, wherein the initial hexahedral mesh is selected from the group consisting of an all-hexahedral swept mesh, multiple all-hexahedral swept meshes for a subdivided geometric entity, a quadrilateral mesh from a source surface to a target surface, and combinations thereof.

13. The method of Claim 9, wherein the six quadrilateral faces for each 3D hexahedron include three sets of opposing faces, and wherein generating a sheet includes:

selecting a first hexahedron, the selected hexahedron having a first set of opposing faces, the first set comprising a first opposing face and a second opposing face;

determining a first neighboring hexahedron, the first neighboring hexahedron sharing the first opposing face with the selected hexahedron;

selecting the first neighboring hexahedron, the first neighboring hexahedron having another face opposite the shared first opposing face;

repeating steps b) and c) until a sheet edge threshold being satisfied;

determining a second neighboring hexahedron, the second neighboring hexahedron sharing the second opposing face with the selected hexahedron;

selecting the second neighboring hexahedron, the second neighboring hexahedron having another face opposite the shared second opposing face;

repeating steps e) and f) until a sheet edge threshold being satisfied;

grouping all selected hexahedrons into a first column of hexahedrons;

selecting the first hexahedron, the selected hexahedron having a second set of opposing faces, the second set comprising a third opposing face and a fourth opposing face;

determining a third neighboring hexahedron, the third neighboring hexahedron sharing the third opposing face with the selected hexahedron;

selecting the third neighboring hexahedron;

repeating steps a) through h) until a second column of hexahedrons is grouped;

selecting the first hexahedron;

determining a fourth neighboring hexahedron, the fourth neighboring hexahedron sharing the fourth opposing face with the selected hexahedron;

selecting the fourth neighboring hexahedron to refine;

repeating steps a) through h) until a third column of hexahedrons is grouped;

repeating steps a) through p) until the sheet edge criterion is met; and

grouping all columns of hexahedrons into the sheet.

14. The method of Claim 9, wherein generating a sheet includes:

selecting a hexahedron, the selected hexahedron having three sets of opposing faces from the six quadrilateral faces, each set including a first opposing face and a second opposing face;

determining a neighboring hexahedron, the neighboring hexahedron sharing one face with the selected hexahedron;

repeating step b) until all neighboring hexahedrons have been found;

selecting the neighboring hexahedron;

repeating steps a) through d) until all hexahedrons in the sheet have been found.

15. The method of Claim 9, wherein determining a group of hexahedrons within said sheet to refine includes:

selecting a hexahedron in the group to refine, the selected hexahedron having three sets of opposing faces from the six quadrilateral faces, each set comprising a first opposing face and a second opposing face;

identifying the one set of opposing faces that are not shared by another hexahedron in the sheet, the set comprising a first unshared opposing face and a second unshared opposing face;

determining a distance between the first unshared opposing face and the second unshared opposing face;

repeating steps a) through c) for each hexahedron in the group to refine;

comparing the distance for each hexahedron in the group to refine;

determining a hexahedron with a shortest distance;

calculating a ratio of the distance for each hexahedron in the group to refine to the shortest distance;

comparing the ratio to a refinement threshold;

grouping each hexahedron identified to refine into the group; and

repeating steps g) through i) for each hexahedral in the group to refine.

16. The method of Claim 9, wherein shrinking said group includes:

moving exterior nodes of the group from an original position into the volume of each hexahedron; and

maintaining a copy of each exterior node in the original position.

17. The method of Claim 9, wherein shrinking said group includes pillowing.

18. The method of Claim 9, wherein inserting a new sheet of hexahedrons into the hexahedral volume mesh includes:

separating each hexahedron in the group from the hexahedral volume mesh;

forming a void in the hexahedral volume mesh; and

inserting the new sheet of hexahedrons into the void.

19. A sheet insertor for modifying a hexahedral mesh, comprising:

a controller for performing the steps of:

generating a sheet of hexahedrons from a hexahedral mesh, wherein the mesh includes a plurality of 3D hexahedrons, and wherein said sheet including a subset of the plurality of 3D hexahedrons;

determining a group of hexahedrons within said sheet to refine;

separating each hexahedron in the group from the hexahedral volume mesh to form a void; and

inserting a new sheet of hexahedrons into the void.

20. The sheet insertor of Claim 19, wherein controller further performing the steps of:

selecting a hexahedron, including three sets of opposing faces, wherein each set includes a first opposing face and a second opposing face;

selecting a neighboring hexahedron, including three sets of opposing faces, the neighboring hexahedron sharing one face with the selected hexahedron; and

selecting a plurality of other neighboring hexahedrons, each neighboring hexahedron comprising three sets of opposing faces, each neighboring hexahedron sharing a face with another hexahedron.

21. The sheet insertor of Claim 19, wherein determining a group of hexahedrons within said sheet to refine includes:

determining a plurality of hexahedrons in the group to refine;

determining a hexahedron with the shortest distance;

determining a ratio of the distance for each hexahedron in the group to the shortest distance and comparing the ratio with a refinement threshold.

22. The sheet insertor of Claim 19, wherein determining a group of hexahedrons includes identifying said group using one a point, line, and surface of the mesh.

23. A method for modifying a hexahedral volume mesh, comprising:

inserting a volume into a hexahedral volume mesh forming an intersection, wherein the mesh includes a plurality of 3D hexahedrons, each 3D hexahedron having eight nodes, each node formed at three intersecting edges;

moving nodes in the hexahedral mesh to surface of intersection with the volume;

inserting a layer of elements on each side of the volume; and

removing the volume.

24. A method for generating a hexahedral volume mesh by mesh cutting, comprising:

generating an initial hexahedral mesh including a plurality of 3D hexahedrons, each hexahedron having a plurality of nodes;

inserting a volume into the initial hexahedral mesh forming an intersection;

moving nodes in the hexahedral mesh to surface of intersection with the volume;

inserting a layer of elements on each side of the volume; and

removing the volume.

25. A mesh cutter for cutting a hexahedral volume mesh, comprising:

a controller for performing the steps of:

generating an initial hexahedral mesh including a plurality of 3D hexahedrons, each hexahedron having a plurality of nodes;

inserting a volume into the initial hexahedral mesh forming an intersecting having a surface; and

inserting a layer of elements on each side of the volume.

26. A method for modifying a volume mesh, comprising:

connecting a plurality of rows of elements of a volume mesh using connecting lines, where said connecting lines, together with associated planes, form a plurality of three-dimensional regions, said plurality of three-dimensional regions forming a sheet of volume mesh elements from said mesh;

determining a plurality of hexahedral elements within said sheet to refine using a predetermined threshold for each one of said plurality;

forming a void between said plurality of hexahedral elements and said mesh;

inserting a new sheet of hexahedral elements into said void to produce a modified form of said volume mesh.

27. A machine-readable medium having stored thereon a plurality of executable instructions, the plurality of instructions comprising instructions to:

connect a plurality of rows of elements of a volume mesh using connecting lines, where said connecting lines, together with associated planes, form a plurality of three-dimensional regions, said plurality of three-dimensional regions forming a sheet of volume mesh elements from said mesh;

determine a plurality of hexahedral elements within said sheet to refine using a predetermined threshold for each one of said plurality;

form a void between said plurality of hexahedral elements and said mesh;

insert a new sheet of hexahedral elements into said void to produce a modified form of said volume mesh.

28. A method for modifying a volume mesh, comprising:

connecting a plurality of rows of elements of a volume mesh using connecting lines, where said connecting lines, together with associated planes, form a plurality of three-dimensional regions, said plurality of three-dimensional regions forming a sheet of volume mesh elements, each mesh element including a plurality of surfaces;

determining at least one node linking a plurality of surfaces in said sheet using a predetermined algorithm;

disconnecting a plurality of said connecting lines, together with a plurality of said associated planes, at said at least one node and removing a portion of said plurality of connecting lines, together with a portion of said plurality of associated planes, in a predetermined direction away from said point to form a void in said mesh;

inserting a new sheet of hexahedral elements into said void to produce a modified form of said volume mesh.

29. A machine-readable medium having stored thereon a plurality of executable instructions, the plurality of instructions comprising instructions to:

connect a plurality of rows of elements of a volume mesh using connecting lines, where said connecting lines, together with associated planes, form a plurality of three-dimensional regions, said plurality of three-dimensional regions forming a sheet of volume mesh elements, each mesh element including a plurality of surfaces;

determine at least one node linking a plurality of surfaces in said sheet using a predetermined algorithm;

disconnect a portion of said connecting lines, together with a portion of said associated planes, at said at least one node and removing said portion in a predetermined direction away from said point to form a void in said mesh;

insert a new sheet of hexahedral elements into said void to produce a modified form of said volume mesh.

30. A method for modifying a volume mesh, comprising:

connecting a plurality of rows of elements of a volume mesh using connecting lines, where said connecting lines, together with associated planes, form a plurality of three-dimensional regions, said plurality of three-dimensional regions forming a sheet of volume mesh elements from said mesh;

inserting a volume including elements within said volume into said mesh at the sheet forming an intersection having a surface between said volume and the mesh;

associating nodes at said surface including adding a plurality of layers to existing mesh elements at the surface;

removing said volume including the elements within said volume to produce a modified form of said volume mesh.

31. A machine-readable medium having stored thereon a plurality of executable instructions, the plurality of instructions comprising instructions to:

connect a plurality of rows of elements of a volume mesh using connecting lines, where said connecting lines, together with associated planes, form a plurality of three-dimensional regions, said plurality of three-dimensional regions forming a sheet of volume mesh elements from said mesh;

insert a volume including elements within said volume into said mesh at the sheet forming an intersection having a surface between said volume and the mesh;

associate nodes at said surface including adding a plurality of layers to existing mesh elements at the surface;

remove said volume including the elements within said volume to produce a modified form of said volume mesh.